Monitoring Water and Air Pollution

From the Depths of the Ocean to the Outer Atmosphere

People, animals, marine life, and plant life on our planet need clean air and clean water to survive. With a long legacy of monitoring and studying pollution in both the ocean and the atmosphere, NESDIS scientists are committed to helping protect what is becoming increasingly valuable on a planet undergoing significant climate change.

Addressing Microplastic Pollution in Earth's Ocean and Lakes

Plastic is the most common type of marine pollution, and it can break down into very small particles. Pieces of plastic that are smaller than 5 mm are known as microplastics, and they are found throughout the world's ocean. Scientists are working to better understand marine microplastics, and their impact on coastal communities, marine ecosystems, and human health.

The National Center for Environmental Information (NCEI) at NESDIS is an open, accessible archive of data and information for people, businesses, and public entities to make informed, data-driven decisions about managing and mitigating microplastic pollution.

In collaboration with the Northern Gulf Institute, NCEI developed the global NCEI Marine Microplastic database and web portal, a treasure trove of accessible, large-scale and long-term data. People can also access an NCEI-developed geoportal and interactive GIS map of the microplastic data. These tools offer a global view of microplastics and their impact to scientists, environmental managers, policy makers, and the general public.

NCEI is working with several international science groups to establish best practices for collecting, analyzing, and reporting on microplastic ocean pollution. Key partners include the European Union's European Marine Observation and Data Network (EMODnet) marine litter database and the Ministry of the Environment Japan (MOEJ).

NCEI, the NOAA Marine Debris Program, and NOAA Gulf of Mexico Sea Grant work together to communicate information about this pollutant to stakeholders beyond the scientific community, to inform the general public on the effects of microplastics on marine ecosystems.

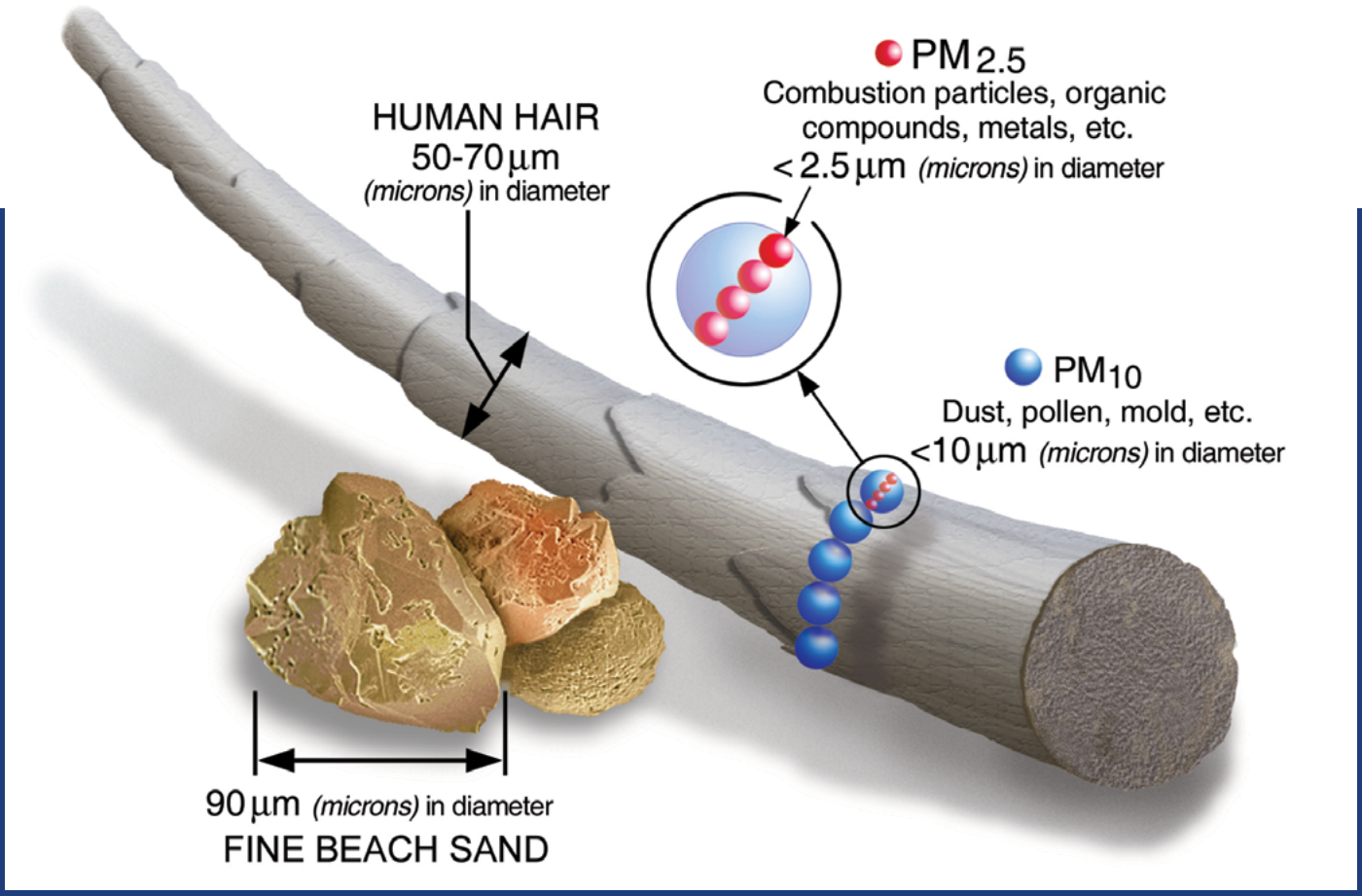
NCEI goes beyond the published scientific data by incorporating community-based scientific data. For instance, in April 2023, NCEI partnered with the non-profit Oceaneye to expand the NCEI marine microplastic database. Oceaneye trains boat captains to collect water samples for study, and promotes community science initiatives to raise awareness about plastic pollution in the ocean.

Most of the data on microplastics is collected from those floating on the ocean surface, but microplastic also ends up on beaches and in ocean sediments. so NCEI is expanding its efforts to add this information to its database. Partnering with Nurdlepatrol.org, an organization operated by the Mission-Aransas National Estuarine Research Reserve at the University of Texas Marine Science Institute, NCEI aims to train people to collect microplastics on beaches.

Filling In The Gaps In Monitoring Air Pollution

Both natural and human sources contribute to air pollution. Exhaust from vehicles, power plants, industrial processes, prescribed and natural fires, and dust storms—among many other sources—release particles into the atmosphere. These particles are incredibly small—20 to 30 times smaller than the thickness of a human hair (see diagram). Once airborne, they can easily be inhaled and can penetrate the lungs and enter bloodstreams. This can lead to harmful health effects including premature death. More than 100,000 people die each year in the United States alone due to poor air quality.

The United States Environmental Protection Agency (EPA) regulates fine particulate pollution as a pollutant



Size comparisons of particulate matter, beach sand, and dust, pollen and other airborne matter. Source: EPA

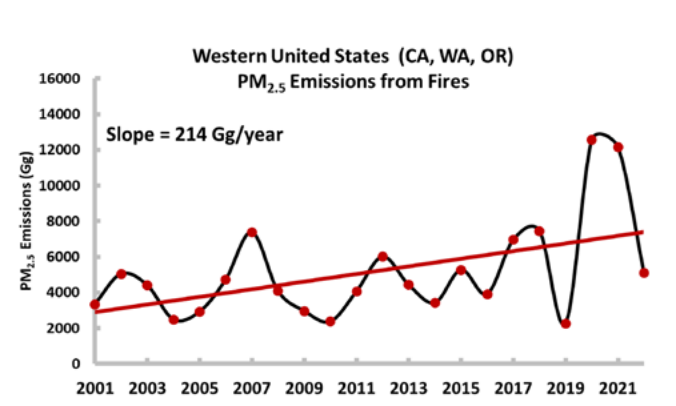
under the Clean Air Act. Levels of fine particulate pollution are expressed as $PM_{2.5}$ (that is, particles with a diameter of 2.5 micrometers or smaller).

To assess trends in air quality and monitor airborne particle pollution, the EPA uses local air pollution monitors. While highly effective, EPA monitors have limited coverage; more than 67 percent of U.S. counties did not have a regulatory monitor in 2019. To fill this coverage gap, NOAA uses satellite data and algorithm formulas to provide vital measurements and information to air quality forecasters, urban leaders, and public health policymakers.

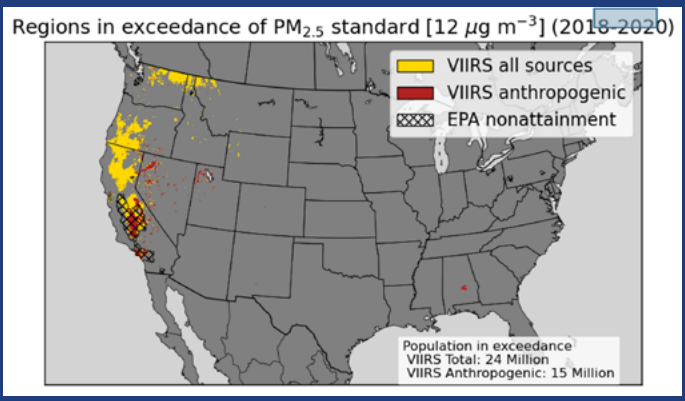
Efforts by state, local, and tribal agencies over the last two decades to meet the EPA health standards are working. However, research also shows that in some areas, fine particulate pollution from wildfires is countering those promising trends. This is especially true in non-urban regions that would otherwise not experience high particulate matter.

Though fire emissions vary from year to year, a warming and drying climate in the western U.S. is increasing fire activity, and increasing $PM_{2.5}$ trends. For example, in California, Oregon, and Washington, NOAA's satellite fire detections show emissions of $PM_{2.5}$ increasing at a rate of 214 gigagrams (Gg) per year—or the equivalent in weight of what would require approximately 16,850 dump trucks to carry.

Breathing in fine particulates in the air that are 2.5 micrometers or smaller can be harmful to our health, raising the risk of asthma, heart disease, and other ailments. High levels of $PM_{2.5}$ can also make the air hazy, reducing visibility. According to NOAA's satellite fire detection readings, the emissions of $PM_{2.5}$ are increasing by roughly half a pound per year.



Trends in $PM_{2.5}$ emissions for the western United States derived by running NOAA's global biomass burning emissions algorithm on NASA's Aqua and Terra Moderate Imaging Spectrometer fire detections.



This figure shows that EPA regulations have worked in decreasing $PM_{2.5}$; most of the United States except parts of California, shown in black meshed markings in the map, are in attainment.

Under EPA regional standards, the NOAA data shows that central California is not attaining $PM_{2.5}$ air quality goals of less than 12 micrograms per cubic meter. Other sources of pollution, such as vehicle exhaust, agriculture and smoke (shown in yellow on the map), prevent Oregon, Washington and other parts of California from attaining EPA standards.

The EPA is preparing to lower the current $PM_{2.5}$ annual standard to 9-10 micrograms per cubic meter. The intent of this proposed regulation is to protect the health of people vulnerable to high levels of pollution, especially children, the elderly, and people with asthma. Scientists are carefully studying wildfires and their role in exposing large populations to harmful levels of smoke, especially in the western U.S. Using satellite-derived data, NOAA estimates there could be a four-fold increase in the number of people exposed to air quality exceeding the new health standard.

Barron Henderson, Ph.D, is a physical scientist in the EPA's Office of Air Quality and Planning Standards. He is currently working with NOAA to add satellite $PM_{2.5}$ data into the EPA's tools for air quality managers. Henderson says, "NOAA's quantitative $PM_{2.5}$ and smoke identification can provide fast screening data that highlight days and locations with large air quality impacts from wildfires." Tools like this that estimate wildfire $PM_{2.5}$ contribution, will be helpful for the states to quantify the effects of fires on air quality.

From NOAA's "eyes in the sky" satellite systems measuring fires and fine particulates, to the sample collectors and researchers tracking seaborn microplastics, NOAA is working around the clock to protect lives and property by helping keep our air and water clean.